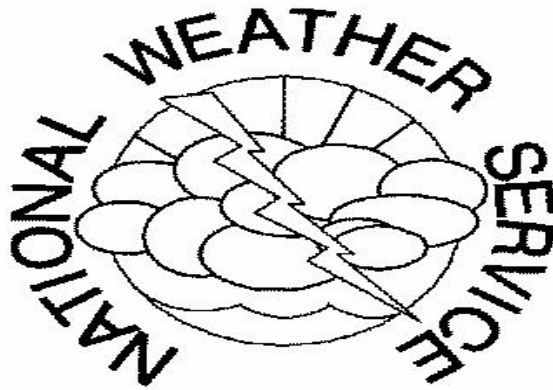


#01-2



**The Father s Day Tornado in Northeast  
Worcester County  
Event Date: June 17th, 2001**

**June 2001**

National Weather Service Forecast Office  
445 Myles Standish Blvd  
Taunton, MA 02780

## **Foreword**

The objective of the National Weather Service Forecast Office (WFO) Taunton Storm Report Series is to provide a concise summary of a significant meteorological event that impacted the WFO Taunton County Warning Area (CWA). The WFO Taunton CWA includes all of Massachusetts except for Berkshire County; all of Rhode Island; Cheshire and Hillsborough Counties in southern New Hampshire; and Hartford, Tolland and Windham Counties in Connecticut.

Use of the series is intended for training and WFO Taunton historical documentation only. Official storm reports can be found in Storm Data, published by the National Oceanic and Atmospheric Administration, National Climatic Data Center.

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June 2001

**WFO Taunton Storm Report Series**  
**#01-2**  
**The Father s Day Tornado in Northeast Worcester County**  
**Event Date: June 17th, 2001**

**1. Introduction**

On June 17<sup>th</sup>, 2001, an F1 tornado struck northeast Worcester County, affecting the town of Princeton. Based on ground and areal surveys, spotter reports and police information, the storm occurred between 1130 am and 1145 am as it tracked northeastward. This storm developed in a tropical environment, as the remnants of once Tropical Storm Allison passed south of the region while interacting with an approaching cold front. The supercell type storm that produced this tornado also produced microburst type wind damage in the communities of Shirley, Lancaster and Sterling. No severe thunderstorm or tornado warnings were issued during the event, but frequent short-term forecasts were issued as much as 30 minutes in advance of the storm and mentioned the likelihood of wind gusts to 50 mph and small hail.

Allison had a history of producing torrential rainfall and situational awareness on the morning of the 17<sup>th</sup> was geared toward that threat. While morning upper air soundings supported deep convection due to the tropical nature of the atmosphere, helicity and shear profiles were not supportive of a supercell environment. However, as the event unfolded, one thunderstorm cluster became detached from a main corridor thunderstorms moving across the central part of the CWA. This separate cluster rapidly spun up and tapped increasing southeast inflow as it moved north northeast into Worcester County. This dramatic backing of the low level wind field played a crucial role in enhancing storm relative helicity and the development of the mesocyclone which produced the F1 tornado.

## **2. Synoptic Overview and NCEP Model Guidance**

The Eta and AVN models were reviewed for this event. The overall synoptic scale picture was forecast well by the models, including the interaction between the remnants of Allison and the evolution of the upper level features. The AVN model provided a superior surface storm track for the remnants of Allison, while both models clearly indicated strong upward vertical motions and the advection of low level moisture into the region ahead of the approaching cold front.

Southern New England was forecast to come under the influence of the right rear quadrant of an approaching 90 kt southerly jet by late morning continuing through the afternoon hours. As is common with this type of interaction between a tropical circulation and a cold front, frontogenesis was forecast to increase into western and central New England by afternoon.

With respect to low level instability and CAPE, the Eta model depicted a rapid increase in CAPE into northern Massachusetts between 1200 UTC and 1800 UTC indicating that rapid destabilization would occur. Also, deep upward vertical motion was forecast as well throughout the eastern half of the forecast region. The apparent missing ingredient for a greater potential for mesocyclone development was low level wind shear. The models were forecasting a weaker low level wind field in the lowest 1-2 km with directional shear of less than 30 degrees. Given these conditions, the primary focus was on the likelihood of widespread thunderstorms with torrential rainfall, rather than a severe or tornadic situation.

The 1200 UTC sounding from Brookhaven (OKX) and Chatham (CHH) depicted a similar situation. CAPE values were quite high for the morning hours with modest lifted indices in the -2 to -4 degree C range. SWEAT and storm relative helicity indices, however, presented little hint of the potential for supercell type development.

A theta-e ridge and a dew point discontinuity was present from eastern Connecticut into southeast New Hampshire. Light northeast winds were occurring on the north end of this boundary with south to southeast winds to the south end. After reviewing radar imagery, it appears this system evolved into a LEWP, with a primary cyclonic vortex developing on the north end of the LEWP. This vortex broke off from the parent line and evolved into a supercell type storm. The near-storm environment did show a very dramatic wind shift as the primary storm rapidly intensified, with the ASOS site at Worcester Airport (ORH) experiencing a wind shift from light northeast to southeast at over 20 kts. The combination of these complex events allowed this one storm to evolve into a tornadic supercell during the late morning hours.

### 3. WSR-88D Imagery

A review of WSR-88D imagery clearly depict the evolution of a line of convection into a Line Echo Wave Pattern (LEWP), which later takes on the classic bow echo or Sea Horse configuration along a north-south axis. As is classic with bow echos, a cyclonic vortex developed on the northern or leading edge of the line, with a broad and weak area of cyclonic storm relative rotation appearing as early as 1345 UTC as depicted in Figures 1a and 1b, entering southeast Hampden County, MA.

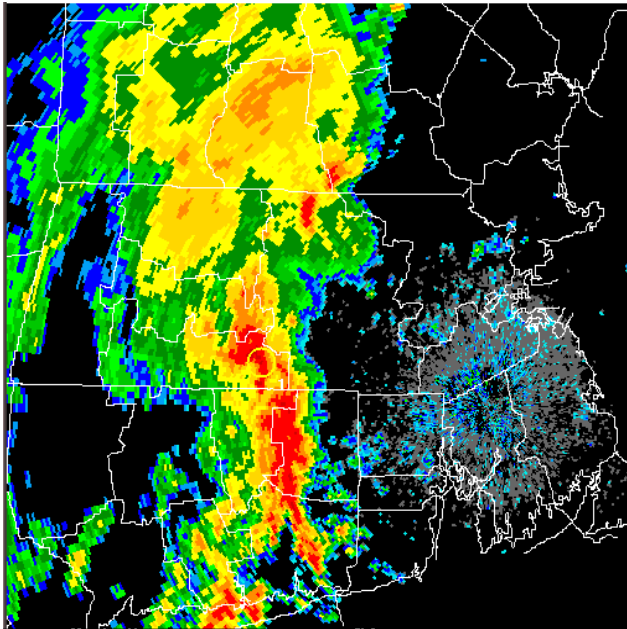


Figure 1a. KBOX Base reflectivity, 0.5 degrees, at 1345 UTC.

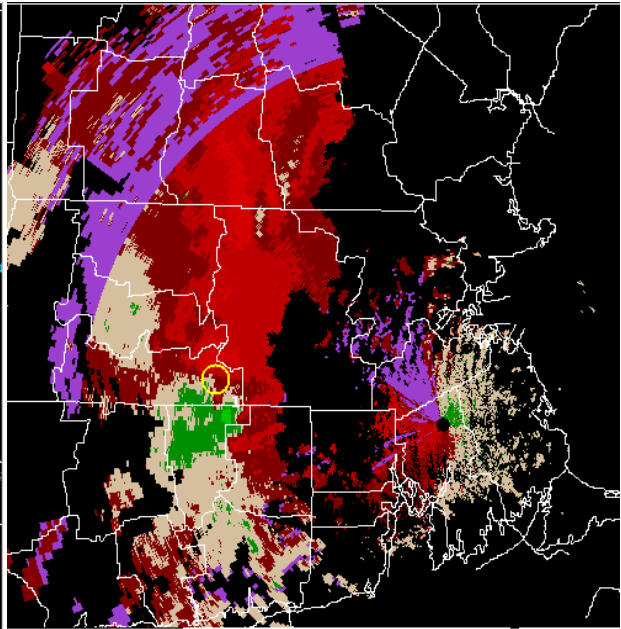


Figure 1b. KBOX Storm relative velocity, 1.4 degrees, at 1345 UTC.

This storm cell continued steadily north northeast and began to separate from the line. By 1432 UTC, as shown in Figures 2a and 2b, a pronounced weak echo channel had developed on the rear inflow side of the storm with the appearance of a narrow flanking line. While no mesos were noted for this storm at this volume scan, a closer look at the 0.5 degree storm relative velocity shows a strengthening, albeit broad, inbound/outbound couplet in southwest Worcester county.

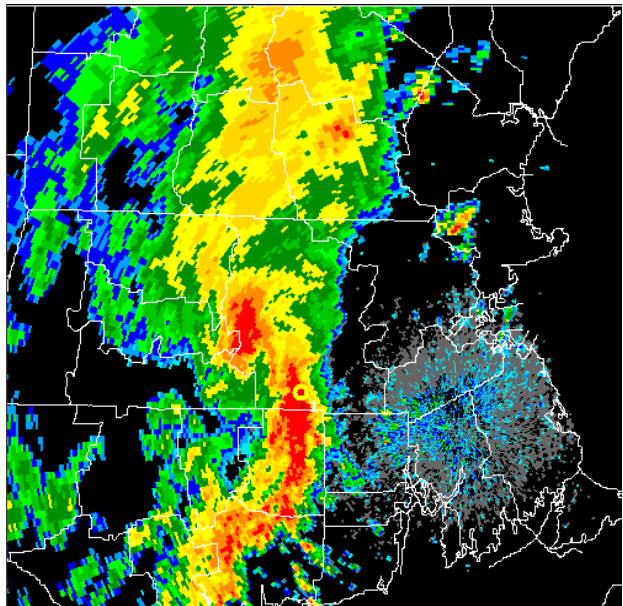


Figure 2a. KBOX Base reflectivity, 0.5 degrees, at 1432 UTC.

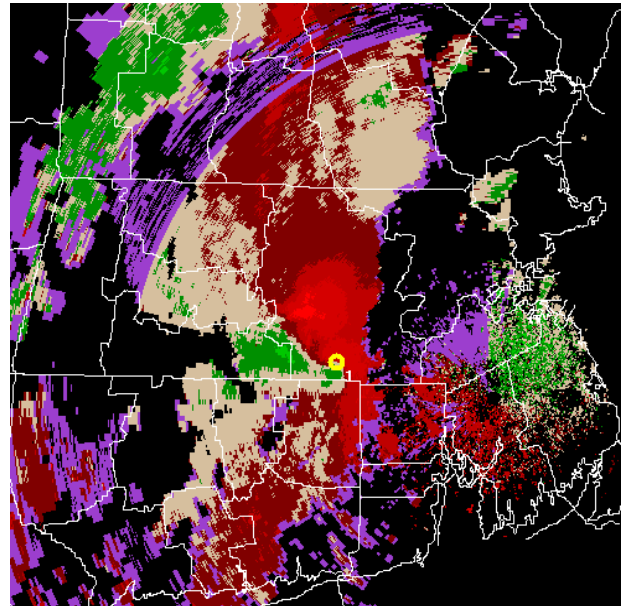


Figure 2b. KBOX Storm relative velocity, 0.5 degrees, at 1432 UTC.

By 1455 UTC, the base reflectivity (Figure 3a) shows that the narrow flanking line has dissipated, while the remainder of the storm is beginning to take on the kidney bean appearance, often associated with a developing heavy precipitation type supercell. The storm relative velocity continued to indicate only a weak but broad area of rotation (Figure 3b).

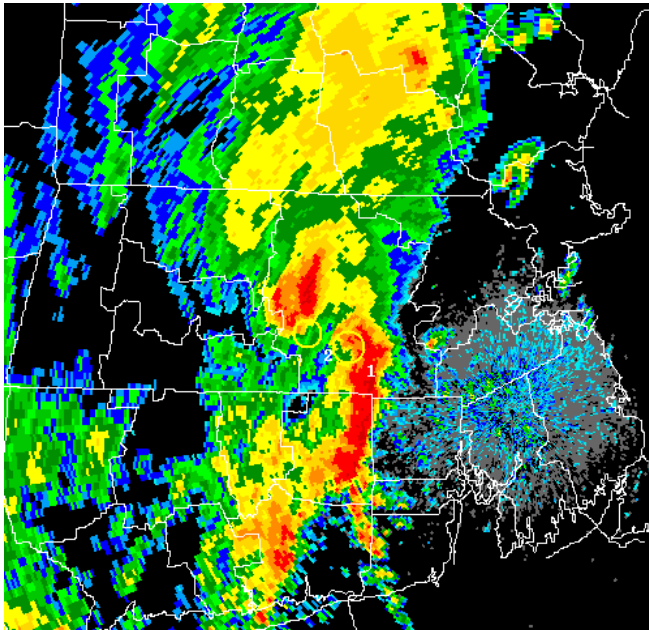


Figure 3a. KBOX Base reflectivity, 0.5 degrees, at 1455 UTC.

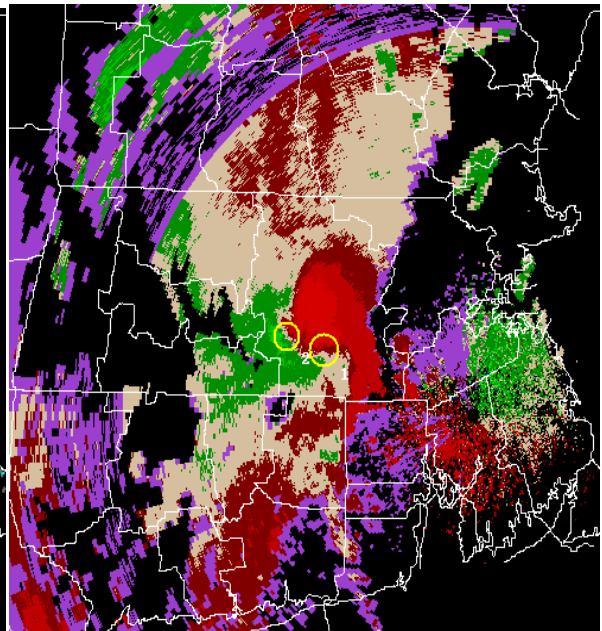


Figure 3b. KBOX Storm relative velocity, 0.5 degrees, at 1455 UTC.

At 1518 UTC, the storm begins to rapidly develop (Figures 4a and 4b). A very strong signature is present in the SRM with v/r shear of  $>45$  kts. By 1524 UTC, a mature supercell is in progress with  $>50$  kts V/R shear as well as the appearance of velocity dealiasing (Figures 5a and 5b).

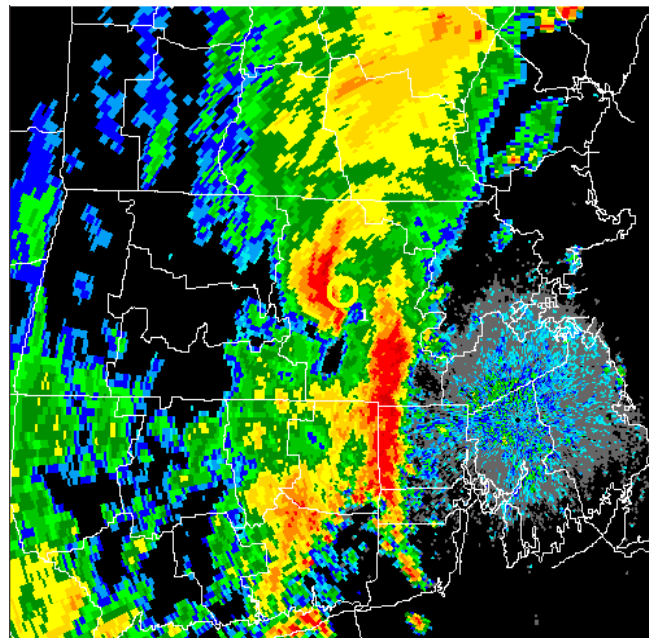


Figure 4a. KBOX Base reflectivity, 0.5 degrees, at 1518 UTC.

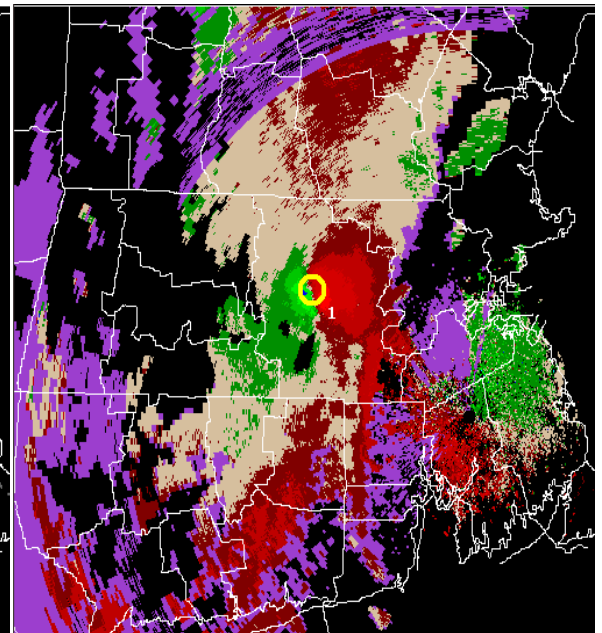


Figure 4b. KBOX Storm relative velocity, 0.5 degrees, at 1518 UTC.

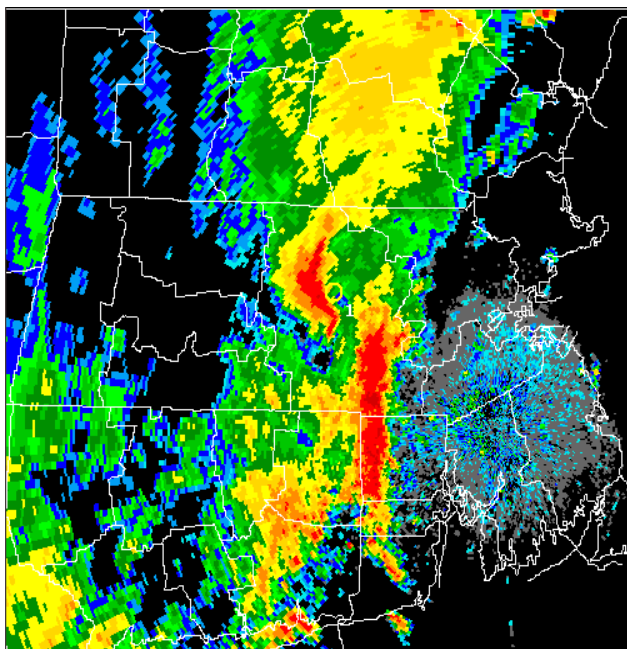


Figure 5a. KBOX Base reflectivity, 0.5 degrees, at 1524 UTC.

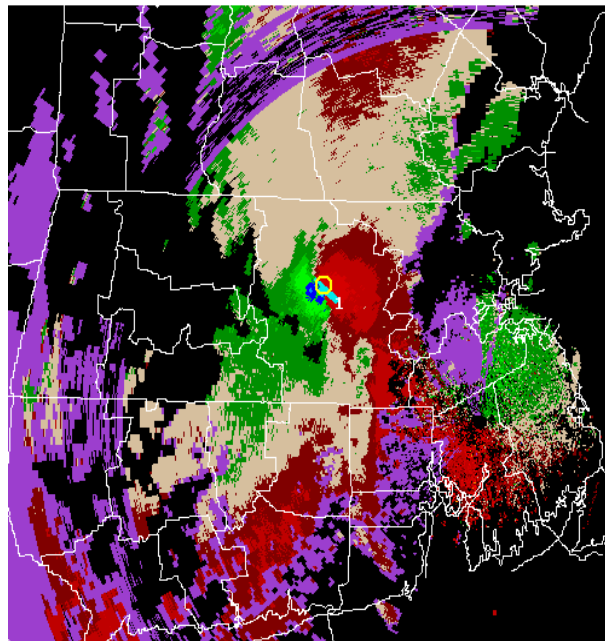


Figure 5b. KBOX Storm relative velocity, 0.5 degrees, at 1524 UTC.

The mesocyclone continues to intensify with a dramatic response in the base reflectivity to this strengthening vortex, as evident in Figures 6a and 6b, valid at 1536 UTC and 7a and 7b, valid 1542 UTC. The F1 is believed to have touched down in Princeton at approximately 1541 UTC.

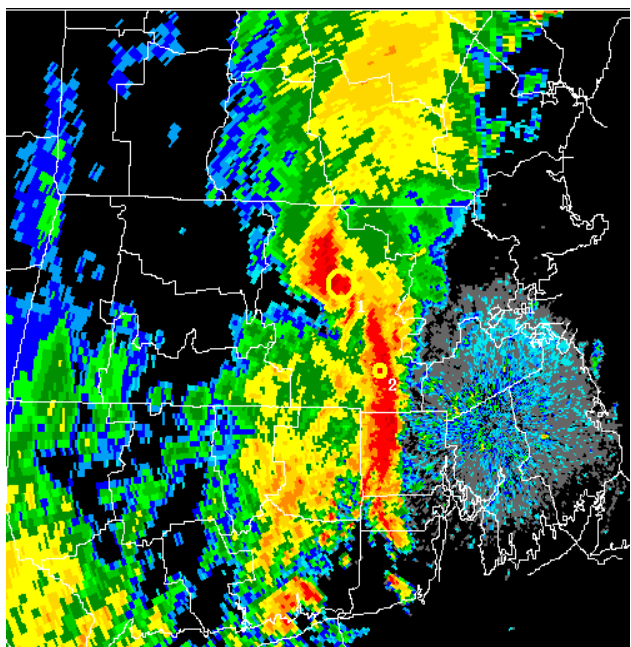


Figure 6a. KBOX Base reflectivity, 0.5 degrees, at 1536 UTC.

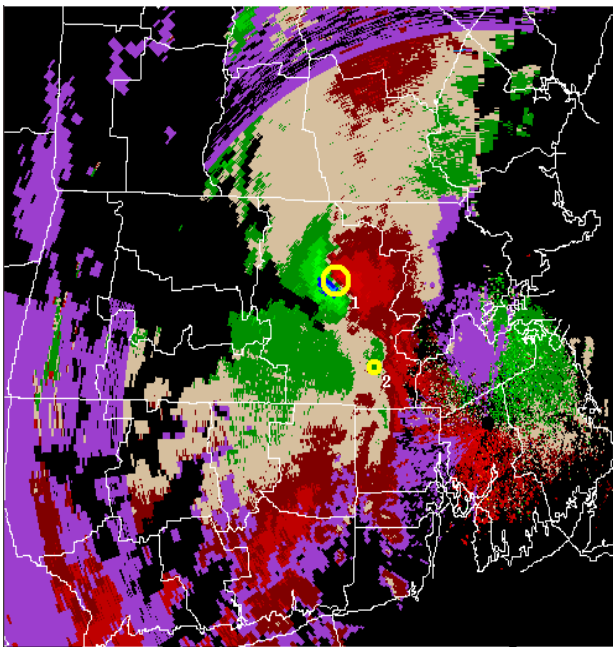


Figure 6b. KBOX Storm relative velocity, 0.5 degrees, at 1536 UTC.

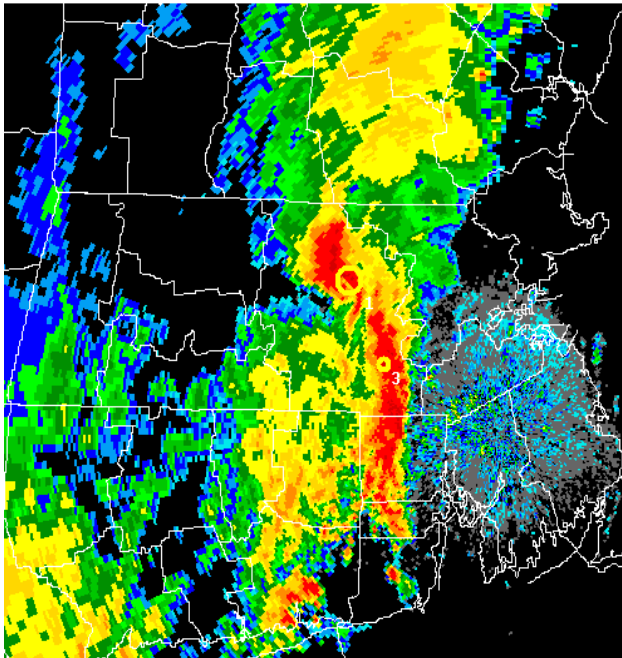


Figure 7a. KBOX Base reflectivity, 0.5 degrees, at 1542 UTC.

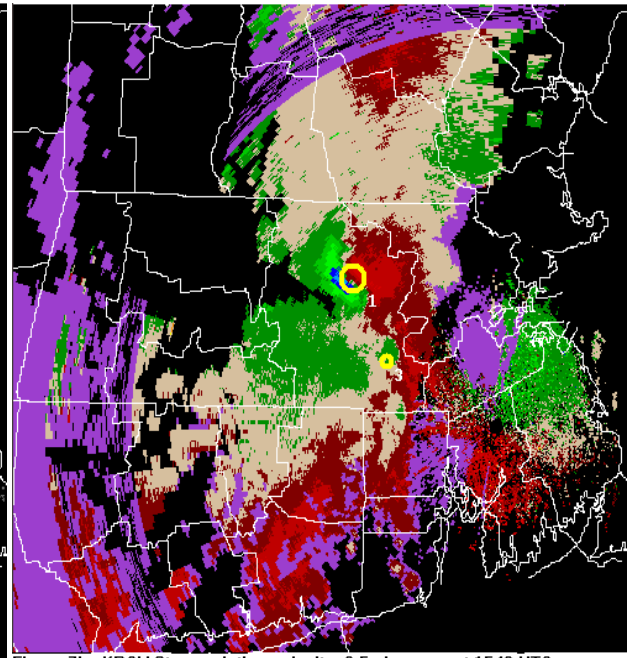


Figure 7b. KBOX Storm relative velocity, 0.5 degrees, at 1542 UTC.

A strong mesocyclone, V/R shear of  $>45$  kts, was maintained through 1605 UTC, as shown in figures 8a and 8b. The last reported wind damage is estimated to have occurred at this time, with scattered microburst type wind damage. The system rapidly weakened by 1611 UTC.

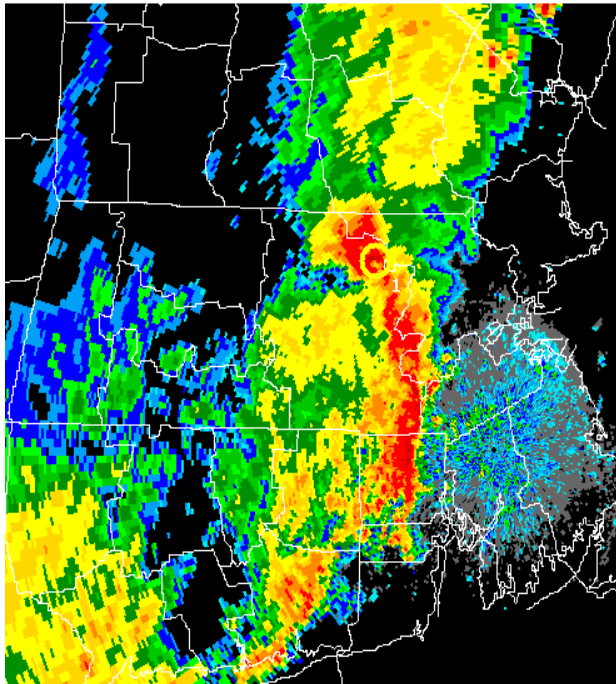


Figure 8a. KBOX Base reflectivity, 0.5 degrees, at 1605 UTC.

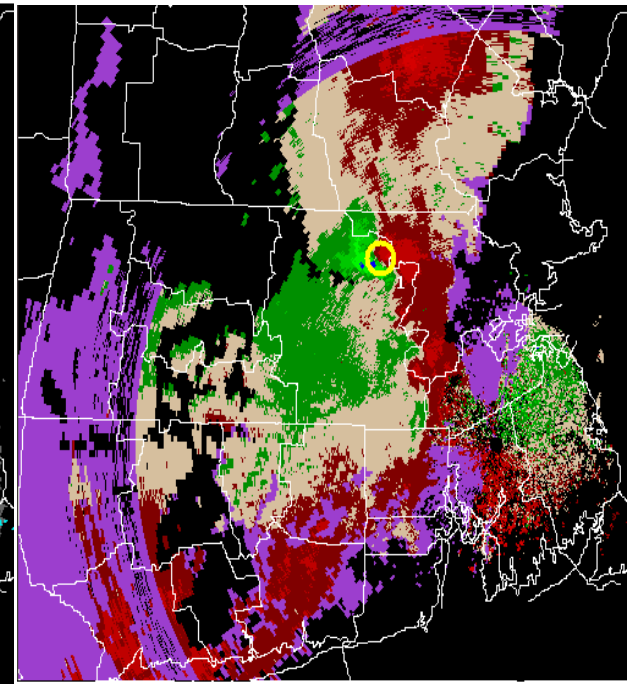


Figure 8b. KBOX Storm relative velocity, 0.5 degrees, at 1605 UTC.

The long lived appearance of rotation and prolonged v/r shear values of  $>45$  kts clearly indicated the potential for this storm to produce severe weather. In addition, looped reflectivity images suggest that this storm became a right mover departing 25 degrees right of the mean wind.

## 4. Storm Impact and Damage Reports

The National Weather Service conducted a ground survey on June 18<sup>th</sup> and an aerial survey by helicopter on the 19<sup>th</sup>. It was determined that a tornado occurred in Princeton Massachusetts and that two microbursts occurred, one in Leominster and the other in Shirley.

### 4.1 Princeton Tornado

The tornado is estimated to have occurred between 1141 AM and 1143 AM in the Coal Kiln road area in the southeast portion of the town of Princeton. The Fujita damage classification rating is F1, which is associated with wind speeds of 73 to 112 mph. The path length was three quarters of a mile with a path width of 1700 feet at its widest point. An areal photograph of the path is provided in Figures 9a and 9b.



Figure 9a. Areal photo of the damage path from the Princeton F1 tornado. View is looking southwest.



Figure 9b. Close up areal photo of the damage path from the Princeton F1 tornado. Track is southwest to northeast (lower left to upper right).

A hundred or more trees were either uprooted or snapped off. A small pop-up type of camper was severely damaged after having been lifted up and deposited on a fallen tree. A tree fell on a house. Thankfully, there were no injuries. Eyewitnesses, including a National Weather Service skywarn spotter, reported large hail just before the tornado struck. The hail was estimated to have ranged from quarter size (1.00 inch) diameter to ping pong ball size (1.50 inches) diameter. There were no reports of any visual sightings of a funnel cloud or tornado. It was likely obscured by heavy rain. This is the first tornado to strike Worcester county in 11 years. On August 10 1990, a F0 tornado was reported. One year earlier, in 1989, the same area of Princeton suffered damage from a microburst. To put the Princeton tornado event in proper perspective, on June 9, 1953, the Worcester tomado was on the ground for 84 minutes, had a path length of 46 miles, and a path width of 1000 yards throughout most of its path. It killed 94 people and injured 1288.

#### 4.2 Leominster microburst

A small downburst, or microburst, occurred in the eastern portion of Leominster near Johnny Appleseed Lane just west of Interstate I-190, as shown from an areal photo in Figure 10. The damage dimensions were roughly ½ mile by 1/3 mile as evidenced by the pattern seen in fallen and uprooted trees. This microburst came within a few hundred yards of a residential neighborhood.



Figure 10. Areal photo of the micro burst in Leominster. Note that the damage swath was extremely close to a residential neighborhood.

#### 4.3 Shirley microburst

Another microburst occurred in Shirley around noon. This one produced tree damage in a path beginning near the east shore of Lake Shirley to Center Road and Parker Road. The ground survey revealed a truck that had been damaged by a tree, smashing its windshield. A skywarn spotter reported a tree down on a car and on a mobile home. A couple of chimneys were reported toppled. Again, thankfully no injuries were reported.

#### 4.4 Other Wind Damage

Scattered tree damage occurred in the towns of Sterling, Holden, and Luenburg from this storm but not clearly definable as independent microbursts.

## **5. Conclusion**

On June 17<sup>th</sup>, 2001, an F1 tornado struck northeast Worcester County, affecting the town of Princeton. Based on ground and areal surveys, spotter reports and police information, the storm occurred between 1130 am and 1145 am as it tracked northeastward. This storm developed in a tropical environment, as the remnants of once Tropical Storm Allison passed south of the region while interacting with an approaching cold front. The supercell type storm that produced this tornado also produced microburst wind damage in the communities of Leominster and Shirley, as well as scattered wind damage in other adjacent communities. No severe thunderstorm or tornado warnings were issued during the event, but frequent short-term forecasts were issued as much as 30 minutes in advance of the storm and did mention the likelihood of wind gusts to 50 mph and small hail.

This hybrid type system again stresses the importance of situational awareness by the forecast staff and the importance of augmenting staffing to monitor widespread convection, especially when there is a threat of heavy rainfall, severe local storms, or the convection is in response to the remnants of a tropical cyclone.